Drone Deliverable Vibration Sensor

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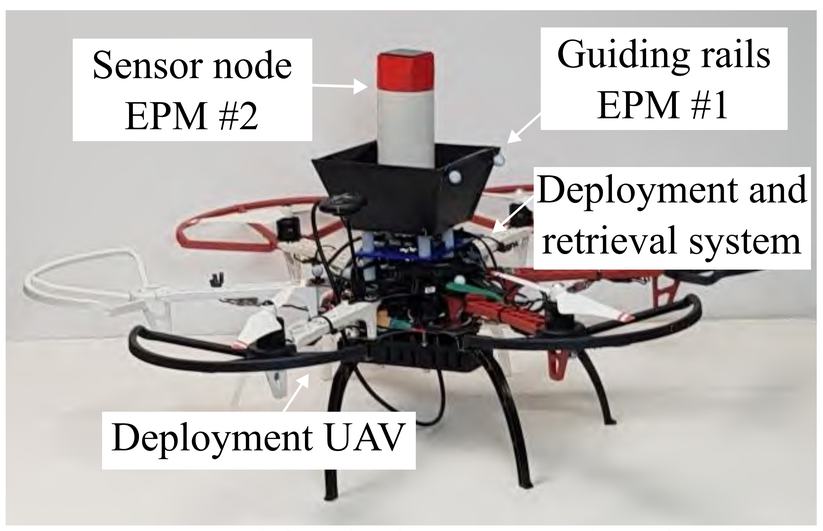
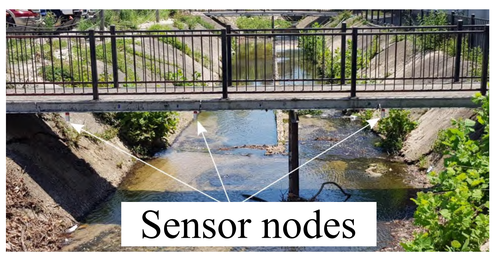
Background

- Vibration in structures is often measured using an accelerometer.
- Knowing about the vibrations occuring in a structure can help to predict when the structure needs maintenance.
- Goals: Create a sensor package with basic components and options for unique situations and test established packages for accuracy.
- Sensor package is drone deployable and open source.
- The drone uses radio frequency (RF) to communicate with electropermanent magnets on the delivery system and sensor package.



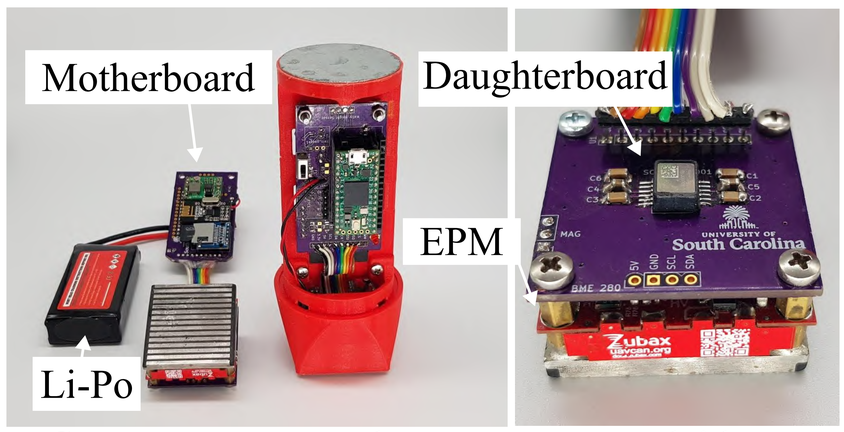
Drone used for deployment and retrieval testing on a pedestrian bridge

- Tests were performed on a pedestrian bridge and a metal beam with two roller supports.



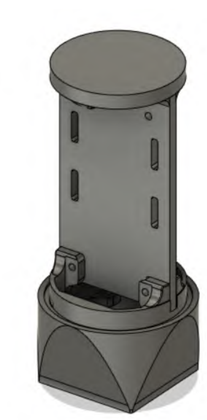
Bridge sensor package testing setup

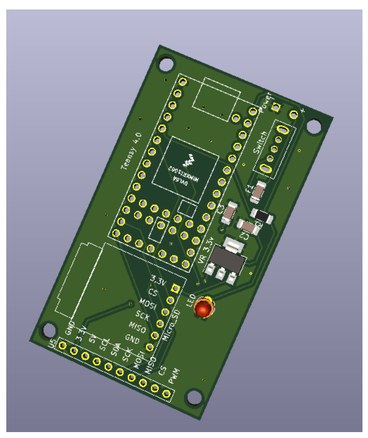
Design



Separate sensor package components laid out

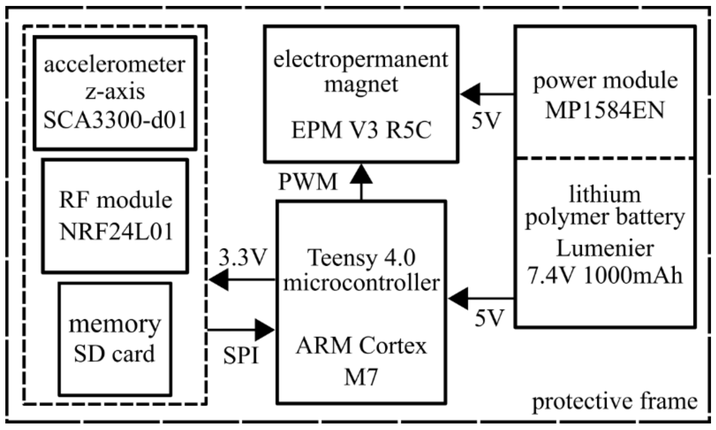
- ARM Cortex-M7 at 600MHz
- 1.48ms average RF communication time
- MEMS Accelerometer
- 2 cell, 7.4V, 1500mAh LiPo battery
- 200N max magnet holding force
- 1.2s magnet charge/discharge cycle





Fusion 360 Housing Unit and KiCAD new design of the PCB

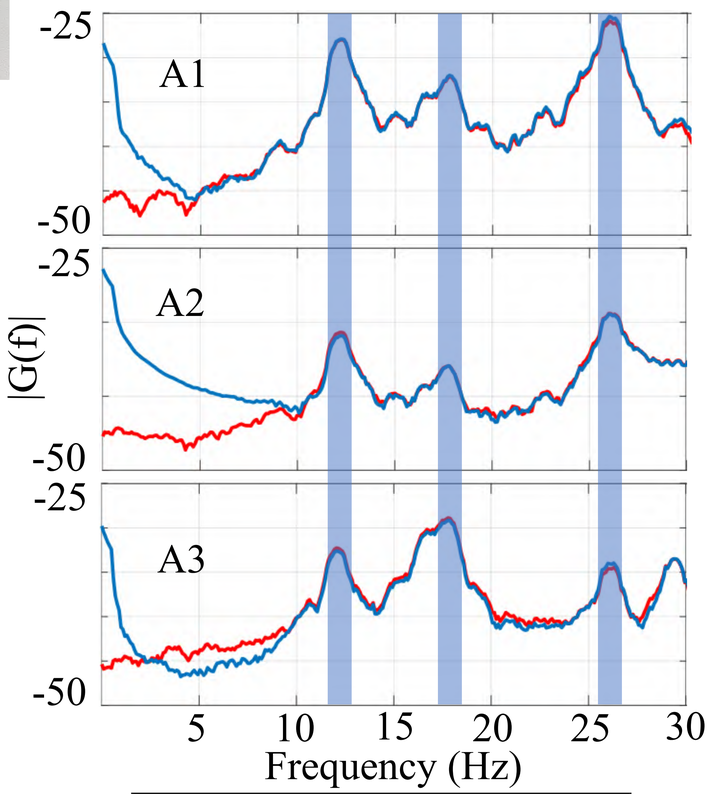
- Housing unit consists of 2 parts. The first houses the EPM and daughter board. The second holds the main board and the LiPo battery.
- EPM can be turned on and off, allowing for drone deployment and retrieval.



Block diagram outlining how the sensor package works

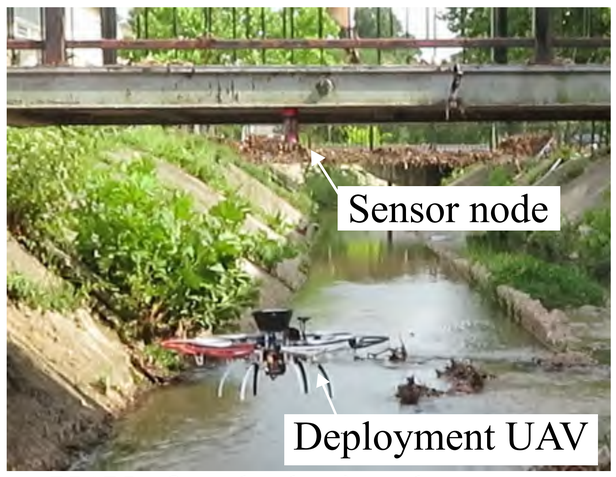
Testing and Results

- Used J352C33 accelerometers as a reference.
- Used 3 accelerometers across 3 spots on a pedestrian bridge behind 300 Main St.
- Tested with sensor 3 sensor packages at the same locations as the references.



Captured frequency spectrum of the walking bridge behind 300 Main St. with the first 3 modes highlighted.

- The first three modes were captured.
- Sensor packages were verified as the data accurately recreates the data from the reference accelerometers.



UAV after deploying the sensor package